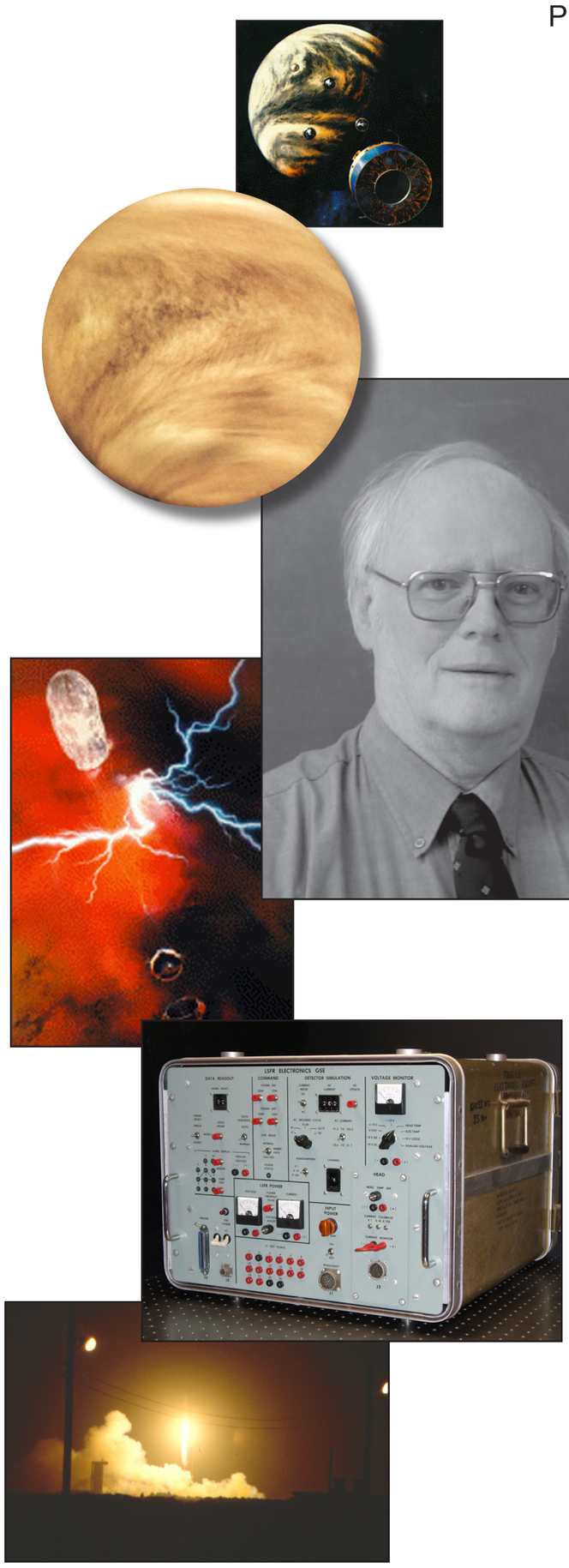
Pioneer Venus Solar Flux Radiometer

James M. Palmer was the chief designer for the Solar Flux Radiometer (LSFR), one of the instruments carried onboard the Pioneer 13 Mission to Venus. He designed the instrument as a graduate student in Optical Sciences at the University of Arizona.



Pioneer 13, the NASA Pioneer Venus Multiprobe, was launched to the planet Venus on August 8, 1978 on an Atlas-Centaur launch vehicle. The spacecraft carried four probes that entered the Venerian atmosphere on December 9 and descended to the planet's surface. The probes carried a variety of experiments to measure atmospheric chemical composition, pressure, density, temperature and solar flux penetration into the atmosphere. At left is an ultraviolet image of Venus' clouds as seen by the Pioneer Venus Orbiter on February 26, 1979.

The LSFR instrument was a 12-channel narrow-field radiometer that used filtered silicon and germanium detectors. Probe rotation provided azimuth scanning during the 55 minute descent through the Venerian atmosphere. There were five fields of view, three looking upward and two downward, each with a five-degree full angle field of view. Sunlight coming through sapphire windows mounted on the hot exterior of the probe was focused by 3mm diameter fused silica lenses onto the end facets of tiny light pipes. The light pipes directed the sunlight through spectral filters to thermally-isolated detectors inside the probe. The flux from 400 to 1800 nm in each field of view was measured and data were transmitted to earth. Operation requirements of the optical head were severe: 375 g entry pulse, and peak mounting surface temperature of 500°C.

The LSFR instrument successfully determined where in the Venerian atmosphere the absorption of solar energy takes place. A measurement of the net solar flux density (upward minus downward) as a function of altitude allowed the calculation of the amount of energy absorbed in the various atmospheric layers. These data provided a means of distinguishing between different types of atmospheric models that were proposed to explain the high surface temperatures (780K) on Venus. Scientific results from the Pioneer Venus mission greatly added to our understanding of Venus, and are also highly relevant to current studies of Earth weather and global warming.

The Principal Investigator for the Solar Flux Radiometer was Dr. Martin Tomasko, of UA's Lunar and Planetary Laboratory. The Instrumentation Co-Investigator was Optical Sciences Professor William L. Wolfe. The instrument was machined and assembled in Optical Sciences' Machine Shop and the light pipes were fabricated in Optical Sciences' Optics Shop.